Effects of Military-Training Activities on Spider Communities of the Fall-Line Sandhills at Fort Benning, Georgia

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Peucetia viridans
(Oxyopidae)

Salticidae (Jumping Spiders)

Abstract

Arthropods have short generation times and rapid population growth, making them ideal indicators of environmental disturbance. In this study, we examined the effect of disturbance caused by military training activities at Fort Benning, GA on species diversity and community composition of spiders in the Fall Line Sandhills. This eco-region is characterized by pines (especially loblolly and longleaf pine), oaks, and sandy soils. We collected spiders from highly, moderately, and lightly disturbed sites, using pitfall traps and sweep nets. Highly disturbed sites had greatly reduced plant cover, much bare soil, gullies, and signs of active erosion, soil compaction, little leaf litter, and evidence of mechanized training. Lightly disturbed sites had normal plant cover, little or no bare soil, and no signs of recent erosion, no obvious soil compaction, and little or no sign of usage by vehicles. There were no differences in species diversity or abundance of spiders per sample (alpha diversity) among the three disturbance regimes. Nevertheless, the low disturbance sites actually had lower beta (among-habitat) diversity. The response of the spiders to disturbance contrasted with that of the ants (in a parallel study not presented here), which had significantly lower species diversity in the heavily disturbed areas.

Introduction

Spiders are potentially important indicators of ecosystem condition. They are common, occur in virtually all habitats, and constitute an important fraction of the animal biomass in terrestrial ecosystems. There are more than 3500 species in the United States. In addition, spiders are frequently the dominant predators in arthropod communities (Glesne, 1998). Because of this, they are good indicators of food web integrity (Wise 1993). When an ecosystem is disturbed, spider abundance and species composition can change (Pyper, 2000). Here, we document some effects of physical disturbance on spider communities of the Fall Line Sandhills of the Upper Coastal Plain of west-central Georgia. We examined species diversity, relative abundance, and species composition in highly disturbed, moderately disturbed, and undisturbed sites. Infantry training and support activity at Fort Benning, Georgia, provided the three disturbance regimes.

Methods and Materials

We established three disturbance regimes, from lightly to moderately to heavily disturbed (Figs. 1-2), all within the Bonham Creek and Sally Branch Watersheds of Fort Benning. We collected specimens over a three year period, from 2000-2002, at three locations within each disturbance regime. All collecting was done in late April to early June of each year via pitfall traps and sweep nets. We identified spiders to genus and morphospecies, using Kaston (1978), Roth (1993), and more specific monographs. We are still in the process of analyzing some specimens from 2002. Here, we present the results for the sweep net samples in 2000 and 2001.

For the statistical analysis, species richness and total numbers were log transformed to stabilize variances. Because number of species is strongly correlated with number of individuals in a sample, we used number of individuals as a covariate in an analysis of covariance.

Table 1. Spider families and morphospecies in low, moderate, and high disturbance regimes in 2000 and 2001 sweep net samples. The first number is the 2000 count, the second is the 2001 count.

Family	Common Name	Low	Moderate	High
Agelenidae	Funnel weavers	0, 2	0, 1	0, 1
Anyphaenidae	Anyphaenid spiders	2, 0	1, 1	1, 1
Araneidae	Orb-weavers	10, 19	17, 20	17, 21
Clubionidae	Sac spiders	1, 1	2, 1	3, 1
Dictynidae	Dictynid spiders	0, 0	2, 1	0, 0
Gnaphosidae	Gnaphosid spiders	1, 2	2, 2	1, 4
Linyphiidae	Sheetweb weavers	2, 0	2, 1	1, 2
Lycosidae	Wolf spiders	0, 0	2, 0	0, 0
Mimetidae	Pirate spiders	0, 1	0, 1	0, 1
Micryphantinae	Dwarf spiders		2, 0	1, 2
1				
Nesticidae	Nesticid spiders	0, 0	0, 1	1, 0
Oxyopidae	Lynx spiders	2, 1	2, 2	2, 2
Philodromidae	Philodromid crab spiders	1, 0	1, 1	1, 0
Salticidae	Jumping spiders	10, 6	8, 9	7, 7
Theridiidae	Cobweb weavers	1, 2	0, 0	1, 0
Thomisidae	Crab spiders	8,11	8, 8	12, 10
Uloboridae	Uloborid spiders	0, 0	1, 1	0, 1
	Unknown	1, 0	2, 1	1, 1

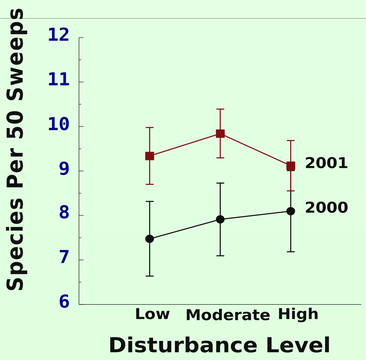

Fig. 3. Number of species in 50 sweeps for 2000 and 2001 sweep net samples, adjusted for number of individuals per sample. Mean ± standard error.

Fig. 1. Cannons (a highly disturbed site)

Fig. 2. Wildlife Plot (a lightly disturbed site) Note the marked Red-cockaded woodpecker trees.

Results

To date, we have identified 182 morphospecies in 18 families in both pitfalls and sweeps. There was no significant difference in number of species per sample (50 sweeps) among the three disturbance regimes (ANCOVA, $F = 0.248$, $df = 2, 14.69$, $P = 0.784$, Fig. 3). There were also no differences in the mean abundance of spiders per sweep sample among the three disturbance regimes (ANOVA, $F = 0.165$, $df = 2, 12.619$, $P = 0.850$, Fig. 4). Nevertheless, when species were pooled across samples within a disturbance regime, there were actually fewer species in the less disturbed sites (Table 1). For the 2000 and 2001 sweeps, there were 41-45 species in the low disturbance regime, and 49-53 species in the moderate to high disturbance regimes.

A DCA ordination (Fig. 5) showed that the three low impact sites had similar species composition, which differed from that of the high impact and moderate impact sites. Nevertheless, the differences were small. Most common species were present in all three disturbance regimes. The most obvious difference was that the low impact sites had fewer species of rare orb weavers (Araneidae). The most widespread and abundant spider at all sites was the green lynx spider (*Peucetia viridans*).

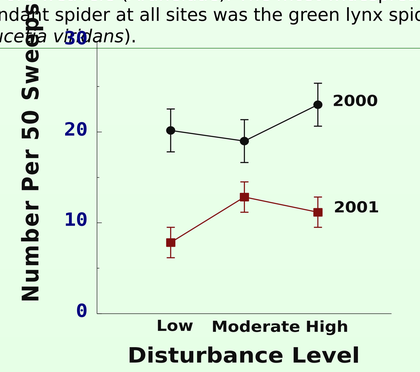

Fig. 4. Number of individuals per 50 sweeps in 2000 and 2001 sweep net samples. Mean ± Standard Error.

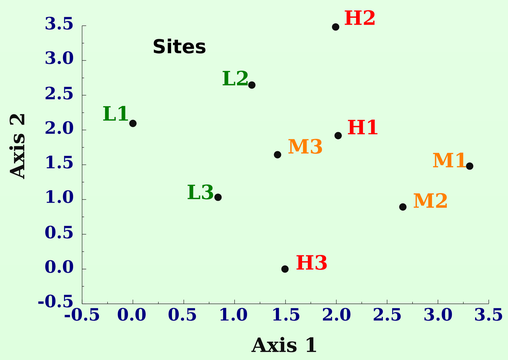

Fig. 5. Detrended correspondence analysis of spider communities in 2001. Undisturbed sites are in dark green, moderately disturbed sites in orange, and heavily disturbed sites in red.

Discussion

Spiders showed no differences in either alpha (within habitat) species diversity or abundance among disturbance regimes. Nevertheless, the moderately and highly disturbed sites had greater beta (among habitat) diversity. There were also some minor differences in community composition between low and moderately to highly disturbed sites. These results differ from those of Glesne (1998), in North Cascades National Park, and McIver et al. (1992), in an Oregon forest, who found considerable differences in community composition and no differences in diversity. Other studies have found decreased abundance when habitat complexity was experimentally reduced (Sundberg and Gunnarsson 1994), and both lower diversity and lower abundance of spiders in drained fens than in natural fens (Kajak et al. 2000).

A parallel study of the ants at Fort Benning showed significantly lower species diversity and greater densities of ants in the highly disturbed sites (Graham, unpublished data**)**. The differences between the ants and spiders may be due partly to the fact that the ants were captured in pitfall traps on the ground. When we finish the count of spiders in the pitfall traps we will be able to make a better comparison. The highly disturbed sites had very little litter.

The greater beta diversity in the disturbed sites may be a consequence of the increased habitat diversity. While the lightly disturbed sites were mostly open longleaf pine woodlands, the disturbed sites contained a mix of pine woodlands and open fields.

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